Australian Government
Australian Transport Safety Bureau

Collision with terrain involving Diamond DA40, VH-MPM

42 km west of Southport Aerodrome, Queensland | 26 September 2017

Investigation

ATSB Transport Safety Report
Aviation Occurrence Investigation
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Addendum

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Safety summary

What happened

On 26 September 2017, an instructor and student conducted a training flight in a Diamond Aircraft Industries DA40 aircraft, registered VH-MPM, from Archerfield Airport, Queensland. The flight training organisation was Aircrew Training and Support Pty Ltd, and the purpose of the flight was a simulated Recreational Pilot Licence (RPL) flight test to prepare the student for an upcoming RPL flight test.

The aircraft entered a developed spin during manoeuvres consistent with advanced stall recovery training which likely included intentional incipient spins. The spin continued until the aircraft collided with terrain. The instructor and student were fatally injured and the aircraft was destroyed.

What the ATSB found

The ATSB found that the aircraft limitation prohibiting intentional spins was intended to include incipient spins. However, the manoeuvre was not defined and some operators considered that the manoeuvre was not an intentional spin. In addition, the aircraft was not certified for developed spin recovery, and the capability of the aircraft to recover from a developed spin had not been established nor was it required to be.

The ATSB also found that the instructor could not or did not prevent the aircraft from entering a developed spin, for reasons that could not be established.

The instructor's flight records showed no evidence of spin training since his initial instructor training in January 2011. After this initial training, there was no requirement for an instructor to undergo any further spin training. However, a week before the accident flight, the student had mishandled the recovery from an incipient spin and the accident flight instructor had taken control of the aircraft and recovered, showing that he had the ability to recover from a spin at that stage of development.

What's been done

The ATSB has issued a Safety Advisory Notice (AO-2017-096-SAN-012) for training organisations conducting incipient spins in non-spin-permitted aircraft.

The Civil Aviation Safety Authority will review incipient spin recovery guidance provided in the *Flight Instructor Manual*.

Safety message

Although the reasons for the accident could not be fully established, the investigation identified varying interpretations of an 'incipient spin'. Operators and pilots should clarify with manufacturers the extent to which the early stages of a spin are permissible and ensure that aircraft are always operated in accordance with limitations.

Furthermore, operators should have procedures, and instructors should take all steps, to ensure that they maintain the necessary skills to avoid unintentional spins and recover from both incipient and developed spins.

The New Zealand Civil Aviation Authority booklet, *Spin Avoidance and Recovery* provides valuable guidance for pilots in spin avoidance and recovery. The booklet provides the following advice for pilots regarding spin recovery:

> To have a chance at recovery, the pilot must immediately recognise the spin, and its direction, know exactly what to do in the right order, and then execute the procedure correctly the first time.

VH-MPM accident site

Source: ATSB

Contents

The occurrence

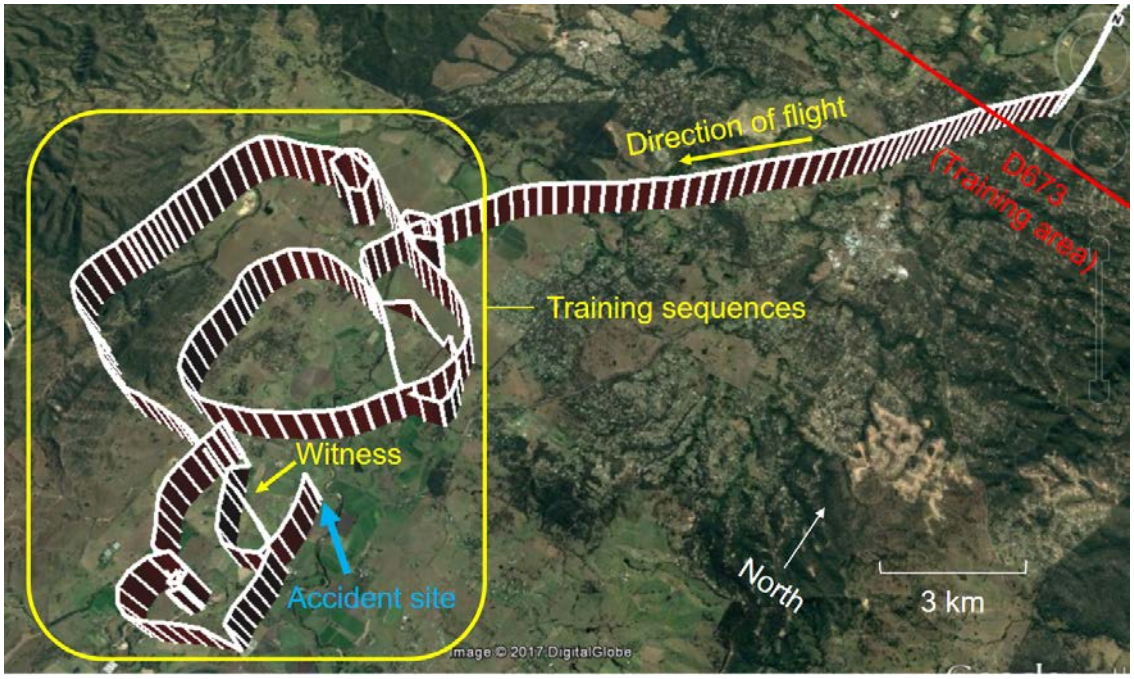
What happened

On the morning of 26 September 2017, an instructor and student conducted a training flight in a Diamond Aircraft Industries DA40 aircraft, registered VH-MPM, from Archerfield Airport, Queensland. The flight training organisation was Aircrew Training and Support Pty Ltd, and the purpose of the flight was a simulated Recreational Pilot Licence (RPL) flight test to prepare the student for an upcoming RPL flight test.

At 0913 Eastern Standard Time (EST),[1] the aircraft departed Archerfield. The aircraft tracked towards the Archerfield training area and climbed to about 3,000 ft above mean sea level (AMSL).

At 0927, the aircraft entered the training area and commenced sequences consistent with a RPL flight test at altitudes between about 2,600 ft and about 4,500 ft AMSL (Figure 1).[2]

Figure 1: Overview of training area sequences



The figure shows the flight path of VH-MPM and location of accident site.
Source: Google Earth and Airservices Australia, annotated by ATSB

From about 0939, radar data showed the aircraft conducted several short climbs followed by brief, rapid descents, which also included changes in heading. These manoeuvres were consistent with advanced stall[3] recovery training (see *Wreckage examination*).

At 0943:08, radar data showed the aircraft commence a climb to about 4,500 ft with a reducing groundspeed, consistent with further stall recovery training. The data then showed the aircraft's flight path to be a near vertical descent with an average descent rate of about 6,000 feet per minute.

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1 Eastern Standard Time (EST): Coordinated Universal Time (UTC) + 10 hours.

2 The ground level elevation over which the aircraft operated in the training area was about 100 ft to 400 ft above mean sea level. The accident site elevation was 167 ft.

3 Aerodynamic stall: occurs when airflow separates from the wing's upper surface and becomes turbulent. A stall occurs at high angles of attack and results in reduced lift.

At 0943:44, as the aircraft descended, the instructor made a MAYDAY[4] broadcast on the area frequency stating '…the aircraft is in a sp…' before the recorded transmission ended.

The descent continued until the aircraft descended below radar coverage with the last recorded radar position almost precisely above the accident site.

A witness, positioned 1.2 km west of the accident site, observed the aircraft turning and described the aircraft in a vertical, tight spiral descent with the aircraft's nose slightly below horizontal, consistent with a spin (see *Aircraft information*). The witness described the spin continue for several complete turns until the aircraft collided with terrain.

Radar data indicates that the aircraft collided with terrain at about 0943:50. The instructor and student were fatally injured by impact forces and the aircraft was destroyed. There was no fire.

[4] MAYDAY: an internationally recognised radio call announcing a distress condition where an aircraft or its occupants are being threatened by serious and/or imminent danger and the flight crew require immediate assistance.

Context

Pilot information

Instructor

General information

The instructor held an Air Transport Pilot Licence (Aeroplane), a flight instructor rating with a Grade 1 training endorsement and a Class 1 aviation medical certificate.

At the time of the accident flight, the instructor had over 3,200 hours of flying experience, of which over 170 hours were on the DA40.

Spin training and knowledge

The regulations required that an instructor complete training in developed spin recovery techniques prior to obtaining an instructor rating. After this initial training, there was no regulatory requirement for an instructor to undergo further spin training.

A review of the instructor's training records showed he underwent developed spin recovery training on 18 January 2011, while training for his initial instructor rating. His employment records and logbooks show no subsequent spin training or assessment. However, there was no requirement to record spins or spin training in pilot logbooks.

Students of the flying school later reported that the instructor advised them of a recent incipient spin (see *Spin classifications and recovery*) occurrence. About a week prior to the accident flight, the same pairing of student and instructor as the accident flight entered an incipient spin during advanced stall recovery training. The instructor had described the student mishandling the recovery of the incipient spin which led to the aircraft entering an incipient spin in the opposite direction. The instructor then took control of the aircraft and recovered to stable flight.

On the day before the accident, the instructor conducted the ground school training of another pilot as part of the training for the issue of an instructor rating. During this training, the pilot presented a briefing on advanced stall recovery training to the instructor, which the instructor reviewed, took notes and provided feedback.

The ATSB assessment of the instructor's feedback and notes indicated that the instructor's knowledge of incipient spin recovery was consistent with established guidelines.

Student

The student was not required to hold, and did not hold, a flight crew licence. The student held a Class 2 aviation medical certificate and had 58 hours of flying experience, of which 19 hours were on the DA40.

Medical information

The ATSB found no indicators that increased the risk of either the instructor or student experiencing a level of fatigue known to have an effect on performance.

Witness reports from family and acquaintances indicate that the instructor and student were in good health and a good mental state prior to the flight. A review of the instructor and student's medical history and the instructor's mobile phone data found no indication that the health and or mental state of the instructor or student contributed to the accident. Post-mortem and toxicological examinations of the instructor and student did not reveal any medical issues that may have contributed to the accident.

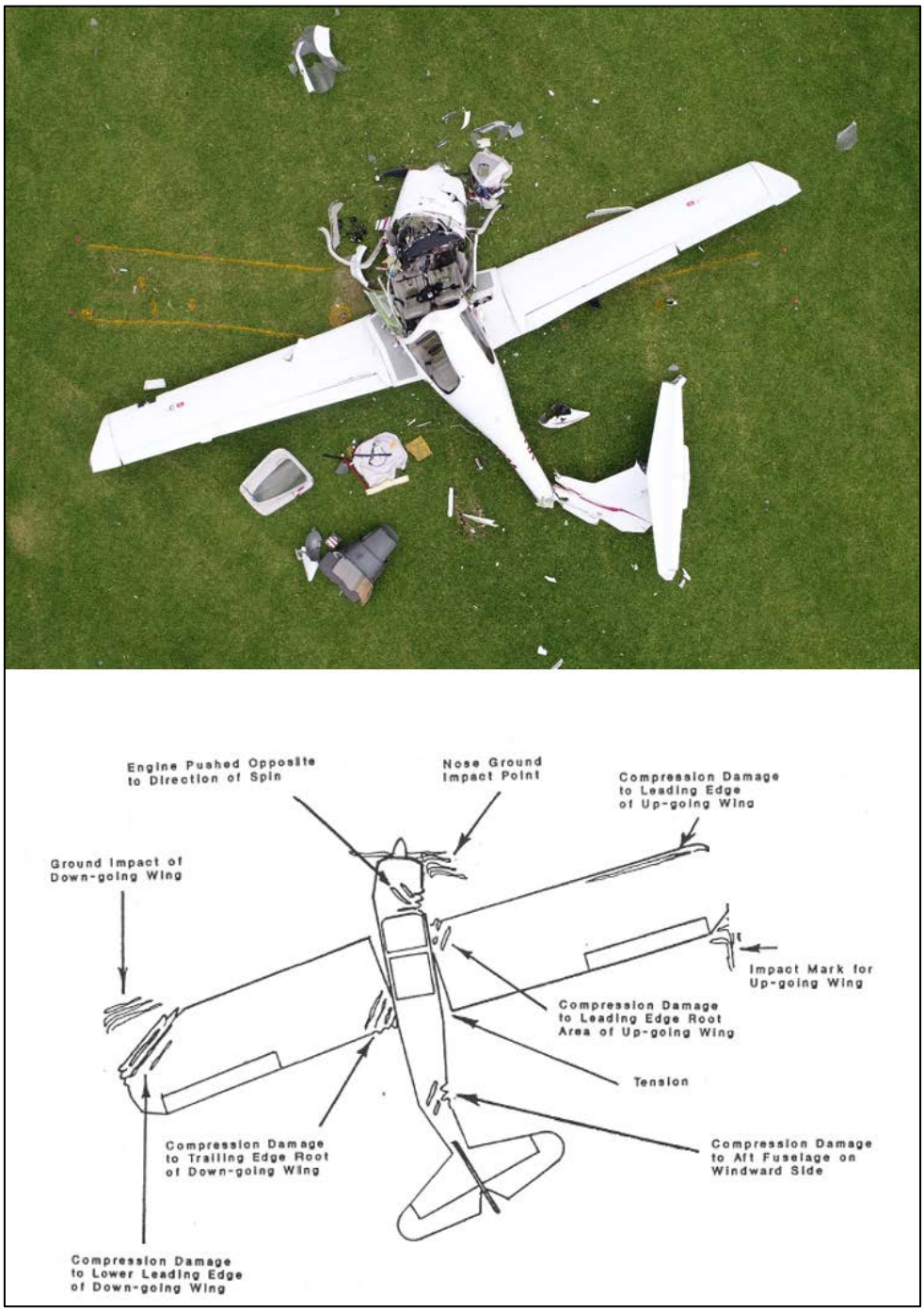
Wreckage examination

The aircraft impacted terrain at an elevation of 167 ft above mean sea level. On-site examination of the wreckage and surrounding ground marks indicated that the aircraft impacted terrain left wing first, nose-down and rotating to the left at low forward speed. This was consistent with a left upright spin (Figure 2).

The forward fuselage separated at the engine firewall. The wings, centre fuselage, and rear fuselage all separated in a direction consistent with a left spin. Evidence from examination of the engine and propeller was consistent with the engine producing low power at the time of the accident. Although the throttle position could not be determined from the wreckage, evidence from the engine and propeller corresponds to the recommended power setting for spin recovery (idle).

The positions of the rudder, ailerons and elevator at the time of the accident could not be determined, however the wing flaps were retracted. Both fuel tanks were ruptured and the fuel selector was selected to the left fuel tank.

Figure 2: Wreckage comparison



The figure provides a comparison between the wreckage of VH-MPM and the expected wreckage pattern for a spin accident as described by Wood and Sweginnis (1995), *Aircraft Accident Investigation*, Source: ATSB and Endeavour Books

Examination of the wreckage and maintenance documentation found no evidence of a pre-existing problem that may have contributed to the accident. The accident was not survivable.

Purpose of the flight

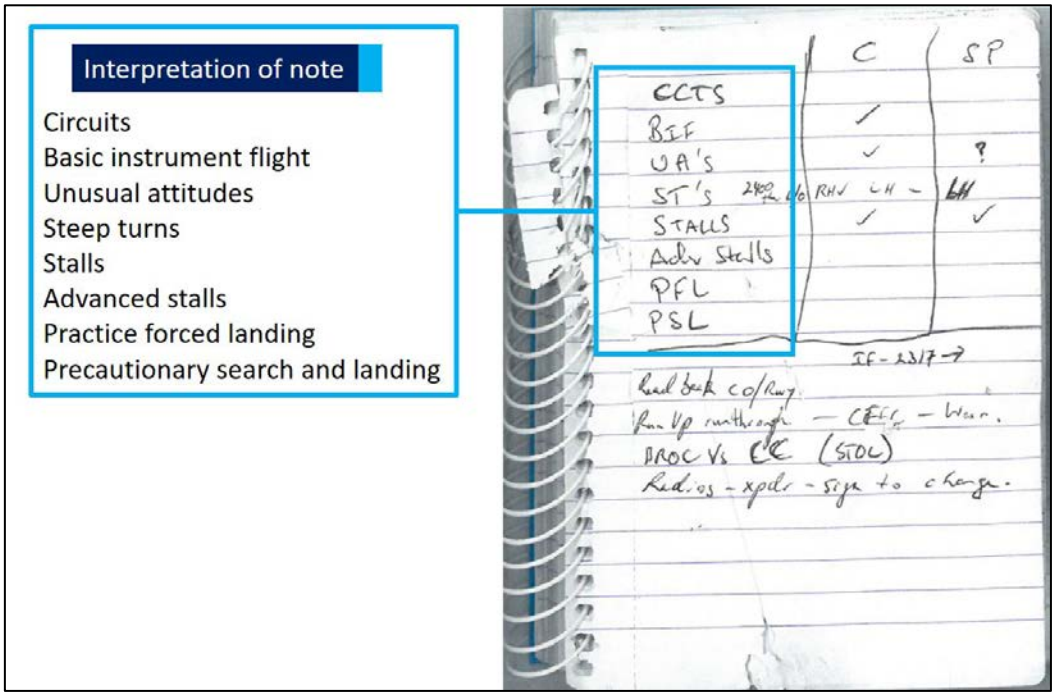
The purpose of the flight was to prepare the student for an upcoming RPL flight test. On the day before the accident, the instructor and student conducted a simulated RPL flight test in accordance with Civil Aviation Safety Authority (CASA) form 61-1486 - *Recreational Pilot Licence – Aeroplane*. During this flight, the instructor determined that the student was not ready for the test. For the flight on the day of the accident, the instructor and student intended to conduct a similar flight to revise the sequences requiring attention.

A handwritten note (Figure 3) was found in the cockpit and was determined to relate to the accident flight. The note listed the following sequences to be conducted in the training area:

- unusual attitudes
- steep turns
- stalls
- advanced stalls
- practice forced landing
- precautionary search and landing.

The order of sequences and markings on the note aligned with the aircraft movements captured by radar. The note indicated that the sequences up to and including stalls had been completed. At the time the aircraft entered the spin, the instructor and student were likely conducting the next incomplete item on the list, which was advanced stall recovery training.

Figure 3: Instructor's note from accident flight



The image shows the note recovered from the aircraft with sequence abbreviations expanded.
Source: Queensland Police annotated by ATSB

The advanced stall recovery training component of the simulated RPL test required a student to demonstrate recovery from incipient spins (see *Aircraft information*) and stalls conducted with different engine power settings, aircraft configurations and entry attitudes.

This sequence requires an instructor or student to configure and manoeuvre an aircraft in a manner that is conducive to an incipient spin. An instructor may also deliberately induce an incipient spin. A student must then demonstrate the correct recovery to stable flight.

The aircraft should not be permitted to enter a developed spin, however, slow recovery action or mishandling during the incipient spin recovery may lead to an aircraft entering a developed spin. If the student does not demonstrate prompt and correct recovery actions, an instructor should take control to prevent the aircraft entering a developed spin.

Aircraft information

General information

The Diamond Aircraft Industries DA40-180 is a four-seat, low-wing, fixed-tricycle-undercarriage aircraft with a glass and carbon fibre reinforced polymer construction. It has a single reciprocating engine driving a variable pitch two bladed propeller (Figure 4). The aircraft was equipped with dual controls for the student and instructor and Garmin G1000 instrumentation. It was not equipped with an aircraft parachute system.

Figure 4: VH-MPM

The image shows VH-MPM prior to the accident.
Source: Operator

VH-MPM was manufactured in 2006 and had a total time in service of 678 hours. It had a valid maintenance release showing no outstanding issues and the last scheduled maintenance was completed on 22 August 2017.

Weight and balance

The aircraft was loaded within weight and longitudinal balance limits for the duration of the flight.

Fuel system and distribution

The aircraft was fitted with a main and auxiliary fuel tank with a combined capacity of 92.5 L in each wing, providing a total fuel capacity of 185 L. A fuel tank selector, positioned on the centre console between the student and instructor, provided for the selection to use fuel from the left or right fuel tanks or to select the fuel off.

Fuel records indicated that the aircraft was loaded with 139 L of fuel prior to departure, sufficient for the planned flight.

The aircraft flight manual contained the following fuel limitation:

> Maximum permissible difference between right and left tanks: 8 US gallons (approximately 30 L)

It was not possible to determine the fuel level in each tank prior to take-off or during the flight. The fuel tanks ruptured during the accident and a significant amount of fuel escaped from each tank. Therefore, the distribution of fuel on board at the time of the accident could not be determined.

Intentional spinning limitation

The aircraft flight manual included a limitation stating that intentional spinning was not permitted in the aircraft.

The manufacturer provided the following comment regarding the conduct of incipient spins in VH-MPM:

> The DA40 used in this accident is not approved for intentional spins, incipient or otherwise. Inducing a spin is outside of the approved envelope of the DA40.

The manufacturer also advised:

> Using rudder deflection to enter an incipient spin, even if the aircraft is immediately recovered from that incipient spin, is an intentional spin and therefore not allowed to be performed with a DA40.

Certification spin testing

The aircraft type was certified in the Normal and Utility categories in accordance with European Aviation Safety Agency (EASA) Joint Aviation Regulations (JAR) part 23.

The aircraft was not approved for intentional spinning, but had been evaluated to meet the requirements of JAR Part 23.221, namely:

a. Normal Category aeroplanes. A single engined, normal category aeroplane must be able to recover from a one-turn spin or a three-second spin, whichever takes longer, in not more than one additional turn, after initiation of the first control action for recovery. In addition –

    1. For both the flaps-retracted and flaps-extended conditions, the applicable airspeed limit and positive limit manoeuvring load factor must not be exceeded;
    2. No control forces or characteristic encountered during the spin or recovery may adversely affect prompt recovery;
    3. It must be impossible to obtain unrecoverable spins with any use of the flight or engine power controls either at the entry into or during the spin; and
    4. For the flaps extended condition, the flaps may be retracted during the recovery but not before rotation has ceased.

b. Utility category aeroplanes. A utility category aeroplane must meet the requirements of sub-paragraph (a).

The certification report stated that the aircraft exhibited prompt incipient spin recovery behaviour within the certification requirements. The manufacturer was not required to and did not test the aircraft for fully developed spin behaviour and recovery.

Developed spin recovery

While, the flight manual prohibited intentional spinning, the manual provided the procedure shown in Figure 5 to assist in recovery from an unintentional spin.

Figure 5: Unintentional spin recovery checklist

3.6 RECOVERY FROM AN UNINTENTIONAL SPIN

CAUTION

Steps 1 to 4 must be carried out **immediately** and **simultaneously**.

1.	Throttle	IDLE
2.	Rudder	full deflection against direction of spin
3.	Elevator (control stick)	fully forward
4.	Ailerons	neutral
5.	Flaps	UP

When Rotation Has Stopped:

6.	Rudder	neutral
7.	Elevator (control stick)	pull carefully
8.	Return the airplane from a descending into a normal flight attitude. In so doing do not exceed the 'never exceed speed', v_{NE}.	

END OF CHECKLIST

Source: Diamond Aircraft

Aerodynamic spins

An aerodynamic spin is a sustained spiral descent in which an aircraft's wings are in a stalled condition, with one wing producing more lift than the other. This difference in lift sustains the rotation and keeps the aircraft in the spin. The nose angle can also vary considerably. In a fully developed, upright, left spin, an aircraft will simultaneously roll[5] to the left while yawing[6] to the left, making a vertical corkscrew path through the air. A spinning aircraft will descend more slowly than one in a vertical dive and it will also have a lower airspeed, which may oscillate.

Spin classifications and recovery

The United States Federal Aviation Administration publication *Airplane Flying Handbook, Chapter 4: Maintaining Aircraft Control: Upset Prevention and Recovery Training* provides the following further information regarding spin classification and recovery:

> **Incipient phase**
>
> The incipient phase occurs from the time the airplane stalls and starts rotating until the spin has fully developed. This phase may take two to four turns for most airplanes. In this phase, the aerodynamic and inertial forces have not achieved a balance. As the incipient phase develops, the indicated airspeed will generally stabilize at a low and constant airspeed and the symbolic airplane of the turn indicator should indicate the direction of the spin. The slip/skid ball is unreliable when spinning.
>
> The pilot should initiate incipient spin recovery procedures prior to completing 360° of rotation. The pilot should apply full rudder opposite the direction of rotation. The turn indicator shows a deflection in the direction of rotation if disoriented.
>
> Incipient spins that are not allowed to develop into a steady-state spin are the most commonly used maneuver in initial spin training and recovery techniques.

[5] Roll: the movement of an aircraft about its longitudinal axis.

[6] Yawing: the motion of an aircraft about its vertical or normal axis.

> **Developed phase**
>
> The developed phase occurs when the airplane's angular rotation rate, airspeed, and vertical speed are stabilized in a flightpath that is nearly vertical. In the developed phase, aerodynamic forces and inertial forces are in balance, and the airplane's attitude, angles, and self-sustaining motions about the vertical axis are constant or repetitive, or nearly so. The spin is in equilibrium. It is important to note that some training airplanes will not enter into the developed phase but could transition unexpectedly from the incipient phase into a spiral dive. In a spiral dive the airplane will not be in equilibrium but instead will be accelerating and G load can rapidly increase as a result.

The New Zealand Civil Aviation Authority booklet, *Spin Avoidance and Recovery* provides further useful information. The booklet also provides the following guidance regarding developed spin recovery:

> The minimum altitude loss for a textbook recovery will be about 1000 to 1500 feet.

The Australian Civil Aviation Safety Authority did not provide guidance defining the incipient spin manoeuvre.

During the investigation, the ATSB discussed the manoeuvre with the operator's Head of Operations, the operator's previous Head of Operations and the Head of Operations of the instructor's previous employer.

- The operator's Head of Operations described conducting 'wing-drop' manoeuvres in the DA40.
- The previous Head of Operations commented that incipient spins in the DA40 were risky as spins were prohibited for the aircraft type. This made training in the aircraft difficult.
- The Head of Operations of the instructor's previous employer advised that the flight test requirement was to conduct 'wing-drop stalls' and that this did not constitute spinning.

Civil Aviation Safety Authority

Appropriate use of aircraft

CASA provided the following comment regarding training operations using aircraft which are not approved for intentional spins:

> If the operator does not have a suitable type of aircraft for a particular kind of training, then CASA would expect the operator to make appropriate arrangements to acquire or loan a suitable aircraft. The Head of Operations of a training operator has the responsibility to ensure the proper allocation and deployment of aircraft.

Incorrect guidance

While the ATSB assessed that the instructor's incipient spin recovery knowledge was consistent with established guidelines and did not contribute to the accident, the investigation identified incorrect incipient spin recovery guidance provided by CASA.

The CASA publication *Flight Instructor Manual*, provides the following guidance for incipient spin recovery:

> **RECOVERY FROM THE INCIPIENT STAGE**
>
> As soon as the aeroplane has stalled and commenced to yaw take the appropriate recovery action. Increase power, apply sufficient rudder to prevent further yaw and ease the control column forward sufficiently to un-stall the aeroplane. Point out that if power is to materially assist recovery action it must be applied before the nose of the aeroplane has pitched too far below the horizon otherwise its use will only increase the loss of height.

Increasing engine power prior to an application of sufficient rudder to prevent further yaw and applying sufficient nose-down elevator un-stall the wings as described is inconsistent with established guidelines and manufacturer guidance.

The United States Federal Aviation Administration publication *Airplane Flying Handbook, Chapter 4: Maintaining Aircraft Control: Upset Prevention and Recovery Training* provides the following guidance, consistent with established guidelines, regarding spin recovery:

> To accomplish spin recovery, always follow the manufacturer's recommended procedures. In the absence of the manufacturer's recommended spin recovery procedures and techniques, use the spin recovery procedures in the spin recovery template. If the flaps and/or retractable landing gear are extended prior to the spin, they should be retracted as soon as practicable after spin entry.
>
> Spin recovery template:
>
> 1. Reduce the Power (Throttle) to Idle
> 2. Position the Ailerons to Neutral
> 3. Apply Full Opposite Rudder against the Rotation
> 4. Apply Positive, Brisk, and Straight Forward Elevator (Forward of Neutral)
> 5. Neutralize the Rudder After Spin Rotation Stops
> 6. Apply Back Elevator Pressure to Return to Level Flight.

The handbook also provides further guidance regarding power use during spin recovery:

> Reduce the Power (Throttle) to Idle. Power aggravates spin characteristics. It can result in a flatter spin attitude and usually increases the rate of rotation.

CASA advised the ATSB that this matter will be referred to Safety Education for review and correction as required.

Meteorological information

Data recorded by the automatic weather station at Beaudesert, Queensland, 7 km southeast of the accident site, was provided by the Bureau of Meteorology. The site recorded observations at 30-minute intervals. The recorded observations from 13 minutes prior to, and 17 minutes after the accident, indicated that light winds and clear conditions prevailed.

Video footage obtained from another aircraft operating in the Archerfield training area at the time of the accident showed smooth flying conditions, visibility in excess of 10 km and no cloud at, immediately above, or below 4,500 ft.

Flight data recording

The aircraft was not required to be, and was not, fitted with a flight data recorder.

The aircraft was equipped with Garmin G1000 instrumentation. When fitted with a data card in the relevant port, this system was capable of recording multiple parameters relating to the operation of the aircraft and its systems.

The aircraft did not have a data card installed in the relevant port during the accident flight, therefore no data was recorded.

Similar occurrences

A review of the ATSB occurrence database for the period 2009 to 2019 found the following occurrences involving incipient spin training in aircraft are not approved for intentional spinning:

Occurrence 201704820 – VH-YTE – S.O.CA.T.A. – Groupe Aerospatiale TB-10

At the end of the advanced stalling lesson, the instructor was intending to observe the student's wing drop recovery. The instructor initiated a right wing drop, however the student's incorrect use of full aileron during recovery led to spin entry to the right. The instructor took control and recovered the aircraft. The aircraft completed two full rotations and lost 1,200 ft during recovery.

Occurrence 201403058 – VH-EZT – Czech Sport Aircraft – PIPERSPORT

While practicing incipient spins, the instructor initiated a left wing drop. Once the aircraft stalled, the student was asked to recover. The student reduced power with slight delay and applied the incorrect rudder input. The aircraft then turned further left and the instructor directed the application of right rudder. The student did not respond and the instructor took control and initiated spin recovery. The aircraft continued to rotate before recovering about 20 to 30 seconds later. During the recovery the aircraft maximum design load factor was exceeded by 0.1G.[7]

[7] G load: the nominal value for acceleration. In flight, g load represent the combined effects of flight manoeuvring loads and turbulence and can have a positive or negative value.

Safety analysis

Spin entry and non-recovery

The instructor and student were conducting a simulated Recreational Pilots Licence test in preparation for an actual test. This flight included a sequence of advanced stalls that increased the risk of spin entry and likely included intentional incipient spins.

The instructor's note, found within the wreckage, along with radar data, indicated that they were conducting an advanced stall sequence at about 4,300 ft above ground level when the aircraft entered a spin.

Sufficient height was available for the aircraft to recover under normal conditions, however, the flight crew did not recover from the spin before colliding with terrain. Examination of the wreckage showed that the aircraft was in a left spin when it impacted the ground.

The absence of recorded data limited the ability of the investigation to determine how the aircraft entered and why it did not recover from a developed spin. It was not possible to determine whether correct recovery inputs were made during the spin without recovery, or other factors prevented recovery.

Examination of the wreckage and aircraft maintenance history found no outstanding issues or defects which may have contributed to the developed spin, or prevented recovery from an incipient spin.

Instructor spin recovery technique

During the advanced stalling sequence, an instructor initiates an incipient spin, or operates the aircraft in a way which may induce an incipient spin. A student then must demonstrate a prompt recovery to stable flight. Should the student not effect prompt recovery, an instructor should take control of the aircraft and effect recovery prior to entering a developed spin.

The ATSB were advised that a week before the accident flight, the accident flight student had mishandled the recovery from an incipient spin leading to an incipient spin in the opposite direction. The accident flight instructor had taken control of the aircraft and recovered, showing that he had the ability to recover from a spin at that stage of development. However, the aircraft movement or instructor and student actions may have been different on the accident flight.

Intentional incipient spinning not permitted in the aircraft

The flight was being conducted as a simulated Recreational Pilots Licence test. This test requires that a student demonstrate an ability to recovery from an incipient spin. Therefore, the flight requires that an intentional incipient spin be induced in order for the student to demonstrate that ability.

The aircraft flight manual included an operational limitation that prevented intentional spinning in the aircraft. The aircraft manufacturer clarified that this limitation includes intentional incipient spins, even if the aircraft is immediately recovered.

There was no clear and consistent definition of the point at which a manoeuvre becomes a spin (or incipient spin) for the purposes of flying training. Discussions with the operator and other flight training organisations, along with the instructor's previous incipient spin training in the aircraft type indicated that different interpretations of the intentional spin limitation existed. The investigation found that the incipient spin manoeuvre has been considered at least by some in industry to not be an intentional spin, as prohibited by some aircraft types. Furthermore, the conduct of the incipient spin manoeuvre using non-spin-permitted aircraft types has been occurring in Australia.

Aircraft spin certification

The aircraft was not certified for and had not been tested for recovery from a developed spin. While test pilots had demonstrated the aircraft type's prompt recovery from a spin of not more than one turn, the capability of the aircraft type to recover from a spin of more turns was not proven. Therefore, the possibility remains that recovery using correct inputs beyond about one full turn or three seconds may not have been not possible.

Findings

From the evidence available, the following findings are made with respect to the collision with terrain involving Diamond DA40, VH-MPM that occurred 42 km west of Southport Aerodrome, Qld, on 26 September 2017. These findings should not be read as apportioning blame or liability to any particular organisation or individual.

Contributing factors

- The instructor could not or did not prevent the aircraft from entering a spin. The spin continued until the aircraft collided with terrain.

Other finding

- Immediately prior to the spin entry, the aircraft was conducting the advanced stalling sequence which likely included incipient spins. Intentional spins were not permitted in the Diamond DA40. The aircraft manufacturer stated that the intentional spin limitation included intentional incipient spins.
- The aircraft was not certified for developed spin recovery and the capability of the aircraft to recover from a developed spin had not been established.

Safety action

Safety advisory notice

Safety advisory notice to training organisations

The ATSB identified concerns relating to the conduct of incipient spin training in aircraft types for which spinning is prohibited.

The DA40 aircraft type is certified to recover from a one-turn spin or a three-second spin (whichever takes longer), and is not proven or certified to be recoverable from a longer spin. The aircraft's manuals state that intentional spins are prohibited. During the ATSB investigation, the aircraft manufacturer clarified that this limitation prohibits any action that is intended to induce a spin, even if the aircraft is immediately recovered.

Aircraft types with similar limitations are currently in use throughout the world for flying training. In Australia, the Civil Aviation Safety Authority requires the demonstration of recovery from an incipient spin during flight tests. However, there is no clear and consistent definition of the point at which a manoeuvre becomes a spin (or incipient spin) for the purposes of flying training.

Crucially, the ATSB found that there can be varying interpretations of an 'incipient spin', and this has led to aircraft not approved for intentional spins being used for incipient spin training and assessment.

Action number: AO-2017-096-SAN-012

Operating an aircraft within the stated limitations is essential to the safe conduct of a flight. Training organisations are required to conduct incipient spin recovery training, which includes intentionally inducing a spin and recovering before it fully develops. Some organisations may be conducting this training in aircraft not approved for intentional spinning. The Australian Transport Safety Bureau advises these training organisations to clarify with aircraft manufacturers the extent to which the intentional entry into the early stages of a spin, including an incipient spin, is permissible.

Additional safety action

Whether or not the ATSB identifies safety issues in the course of an investigation, relevant organisations may proactively initiate safety action in order to reduce their safety risk. The ATSB has been advised of the following proactive safety action in response to this occurrence.

Civil Aviation Safety Authority

CASA has advised the ATSB that they have taken the following safety action:

Guidance material review

CASA is reviewing the Spins and Spirals section of the *Flight Instructor Manual* for correction as required.

General details

Occurrence details

Date and time:	26 September 2017 – 0943 EST	
Occurrence category:	Accident	
Primary occurrence type:	Collision with terrain	
Location:	42 km W of Southport Aerodrome, Queensland	
	Latitude: 27° 54.85’ S	Longitude: 152° 57.18’ E

Instructor details

Licence details:	Air Transport Pilot Licence, issued February 2016
Endorsements:	Manual Propeller Pitch Control; Retractable Undercarriage
Ratings:	Multi-Engine Aeroplane; Single Engine Aeroplane; Instrument Multi-Engine Aeroplane; Instrument Approach Procedure 2D/3D; Night Visual Flight Rules Single Engine Aeroplane; Flight Instructor Rating Grade 1
Medical certificate:	Class 1, valid to 29 September 2017
Aeronautical experience:	3,233 hours
Last flight review:	February 2016

Student details

Medical certificate:	Class 2, valid to 19 June 2019
Aeronautical experience:	58 hours

Aircraft details

Manufacturer and model:	Diamond Aircraft Industries DA 40	
Year of manufacture:	2006	
Registration:	VH-MPM	
Operator:	Aircrew Training and Support Pty Ltd	
Serial number:	40.674	
Total Time In Service	678 hours	
Type of operation:	Training	
Persons on board:	Crew – 2	Passengers – 0
Injuries:	Crew – 2 (Fatal)	Passengers – 0
Damage:	Destroyed	

Sources and submissions

Sources of information

The sources of information during the investigation included the:

- aircraft manufacturer
- aircraft operator
- Civil Aviation Safety Authority
- air traffic radio recordings
- air traffic radar data
- witnesses
- Bureau of Meteorology
- Queensland Police
- other flying training organisations.

References

Wood RH, & Sweginnis RW 1995, *Aircraft Accident Investigation* pp.189 Casper, WY: Endeavor Books.

Civil Aviation Authority of New Zealand 2014, *Spin Avoidance and Recovery*.

Federal Aviation Administration of The United States 2016, *Airplane Flying Handbook*

Civil Aviation Safety Authority 2006, *Flight Instructor Manual Aeroplane*

Submissions

Under Part 4, Division 2 (Investigation Reports), Section 26 of the *Transport Safety Investigation Act 2003* (the Act), the Australian Transport Safety Bureau (ATSB) may provide a draft report, on a confidential basis, to any person whom the ATSB considers appropriate. Section 26 (1) (a) of the Act allows a person receiving a draft report to make submissions to the ATSB about the draft report.

A draft of this report was provided to the instructor and student's next of kin, the flight training organisation, the aircraft maintainer, the aircraft manufacturer, the Civil Aviation Safety Authority, the Austrian Safety Investigation Authority, the Transportation Safety Board of Canada, the Queensland Coroner's representative and the Hong Kong Civil Aviation Department.

Any submissions from those parties were reviewed and where considered appropriate, the text of the draft report was amended accordingly.

Australian Transport Safety Bureau

The ATSB is an independent Commonwealth Government statutory agency. The ATSB is governed by a Commission and is entirely separate from transport regulators, policy makers and service providers. The ATSB's function is to improve safety and public confidence in the aviation, marine and rail modes of transport through excellence in: independent investigation of transport accidents and other safety occurrences; safety data recording, analysis and research; fostering safety awareness, knowledge and action.

The ATSB is responsible for investigating accidents and other transport safety matters involving civil aviation, marine and rail operations in Australia that fall within ATSB's jurisdiction, as well as participating in overseas investigations involving Australian registered aircraft and ships. A primary concern is the safety of commercial transport, with particular regard to operations involving the travelling public.

The ATSB performs its functions in accordance with the provisions of the *Transport Safety Investigation Act 2003* and Regulations and, where applicable, relevant international agreements.

Purpose of safety investigations

The object of a safety investigation is to identify and reduce safety-related risk. ATSB investigations determine and communicate the factors related to the transport safety matter being investigated.

It is not a function of the ATSB to apportion blame or determine liability. At the same time, an investigation report must include factual material of sufficient weight to support the analysis and findings. At all times the ATSB endeavours to balance the use of material that could imply adverse comment with the need to properly explain what happened, and why, in a fair and unbiased manner.

Developing safety action

Central to the ATSB's investigation of transport safety matters is the early identification of safety issues in the transport environment. The ATSB prefers to encourage the relevant organisation(s) to initiate proactive safety action that addresses safety issues. Nevertheless, the ATSB may use its power to make a formal safety recommendation either during or at the end of an investigation, depending on the level of risk associated with a safety issue and the extent of corrective action undertaken by the relevant organisation.

When safety recommendations are issued, they focus on clearly describing the safety issue of concern, rather than providing instructions or opinions on a preferred method of corrective action. As with equivalent overseas organisations, the ATSB has no power to enforce the implementation of its recommendations. It is a matter for the body to which an ATSB recommendation is directed to assess the costs and benefits of any particular means of addressing a safety issue.

When the ATSB issues a safety recommendation to a person, organisation or agency, they must provide a written response within 90 days. That response must indicate whether they accept the recommendation, any reasons for not accepting part or all of the recommendation, and details of any proposed safety action to give effect to the recommendation.

The ATSB can also issue safety advisory notices suggesting that an organisation or an industry sector consider a safety issue and take action where it believes it appropriate. There is no requirement for a formal response to an advisory notice, although the ATSB will publish any response it receives.

Terminology used in this report

Occurrence: accident or incident.

Safety factor: an event or condition that increases safety risk. In other words, it is something that, if it occurred in the future, would increase the likelihood of an occurrence, and/or the severity of the adverse consequences associated with an occurrence. Safety factors include the occurrence events (e.g. engine failure, signal passed at danger, grounding), individual actions (e.g. errors and violations), local conditions, current risk controls and organisational influences.

Contributing factor: a factor that, had it not occurred or existed at the time of an occurrence, then either:

(a) the occurrence would probably not have occurred; or

(b) the adverse consequences associated with the occurrence would probably not have occurred or have been as serious, or

(c) another contributing factor would probably not have occurred or existed.

Other factors that increased risk: a safety factor identified during an occurrence investigation, which did not meet the definition of contributing factor but was still considered to be important to communicate in an investigation report in the interest of improved transport safety.

Other findings: any finding, other than that associated with safety factors, considered important to include in an investigation report. Such findings may resolve ambiguity or controversy, describe possible scenarios or safety factors when firm safety factor findings were not able to be made, or note events or conditions which ‘saved the day’ or played an important role in reducing the risk associated with an occurrence.

Australian Transport Safety Bureau

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Investigation

ATSB Transport Safety Report
Aviation Occurrence Investigation

Collision with terrain involving Diamond DA40, VH-MPM
42 km west of Southport Aerodrome, Qld, on 26 September 2017

AO-2017-096
Final – 22 May 2019